DEPARTMENT OF TRANSPORTATION
ENGINEERING SERVICE CENTER
Transportation Laboratory
5900 Folsom Blvd.
Sacramento, California 95819-4612

METHOD OF TEST FOR DETERMINING THE EFFECT OF HEAT AND AIR ON A MOVING FILM OF ASPHALT (ROLLING THIN FILM OVEN TEST)

CAUTION: Prior to handling test materials, performing equipment setups, and/or conducting this method, testers are required to read "**SAFETY AND HEALTH**" in Section F of this method. It is the responsibility of the user of this method to consult and use departmental safety and health practices and determine the applicability of regulatory limitations before any testing is performed.

A. SCOPE

This test is used to measure the effect of heat and air on a moving film of semi-solid asphaltic materials. The effects of this treatment are determined from measurements of the properties of the asphalt before and after the test.

A moving film of asphaltic material is heated in an oven for 75 min at 163˚C. The amount of hardening is determined from physical tests. An optional procedure is also provided for determining the change in mass.

B. APPARATUS[1]

1. Oven: This shall be a double-walled, electrically heated convection type. Its inside dimensions are approximately: height 381 mm; width 483 mm, and depth (with door closed) 445 ± 13 mm. The door shall contain a symmetrically located window with dimensions of 305 mm to 330 mm wide by 203 mm to 230 mm high. The window shall contain two sheets of heat-resistant glass separated by an air space. The window should permit an unobstructed view of the interior of the oven. The top of the upper heating element shall be 25 ± 3 mm below the oven floor. The oven shall be vented top and bottom. The bottom vents shall be located symmetrically to supply incoming air around the heating elements. They shall have an open area of 1500 ± 70 mm^2. The top vents shall be symmetrically arranged in the upper part of the oven and have an open area of 930 ± 45 mm^2.

   The oven shall have an air plenum covering the side walls and ceiling; the air space being 38 ± 4.8 mm deep from the walls and ceiling. At a midpoint in the width of the oven and approximately 152 mm from the face of the circular metal carriage to its axis, a squirrel cage-type fan approximately 133 mm O.D. by 73 mm wide shall be turned at 1725 RPM by an externally mounted motor. The squirrel cage fan shall be set so that the fan turns in an opposite direction to its vanes. The air flow characteristics of the fan-plenum system shall be suction from the floor of the oven through the wall plenums and exiting of the air through the fan. Figures 1 and 2 show details of this plenum system.

   The oven shall be equipped with a proportional control thermostat

[1] Complete equipment may be obtained from James Cox and Sons, Inc., Colfax, California.

capable of maintaining 163 ± 0.5˚C. The sensing element of the thermostat shall be placed approximately 25 mm from the left side and approximately 38 mm from the ceiling of the interior of the plenum enclosed oven so that the end of the sensing element is at a point approximately 203 mm from the rear interior wall of the oven. The thermometer shall be hung or affixed to a mounting in the ceiling, which is approximately 50 mm from the right side of the oven, at a mid-point in the depth of the oven. The thermometer shall hang down into the oven so that the bulb of the thermometer is within approximately 25 mm of an imaginary line level to the shaft of the circular metal carriage. The heating controls shall be capable of bringing the fully loaded oven back to the test temperature within a 10-minute period after insertion of the samples in a preheated oven.

The oven shall be provided with a 305 ± 3 mm diameter vertical circular carriage (see Figure 2 for details). This carriage shall be provided with suitable openings and clips for firmly holding eight glass containers (see Figure 3) in a horizontal position. The vertical carriage shall be mechanically driven through a 19 mm diameter shaft at a speed of 15 ± 0.2 RPM.

The oven shall be equipped with an air jet positioned to blow heated air into each bottle at its lowest point of travel. The air jet shall have an outlet orifice 1.016 mm in diameter (No. 60 drill size) connected to a 7.6 m length of 8 mm O.D. copper tubing. This tubing shall be coiled to lie flat on the bottom of the oven and lead to a source of fresh-dried, dust-free regulated air.

NOTE: Activated silica gel treated with an indicator is a satisfactory desiccant for the to dry air.

2. Flowmeter: The flow meter may be any suitable type capable of accurately measuring the air flow at a rate of 4000 mL/min at the outlet of the copper tube.

3. Thermometer: This shall be a Loss on Heat thermometer conforming to specifications for ASTM No. 13C-86, Table 2, ASTM Designation E 1.

4. Container: The container in which the sample is to be tested shall be of heat-resistant glass conforming to the dimensions shown in Figure 3.

C. PREPARATION OF OVEN

1. Position the air outlet orifice so that it is 6.4 ± 1.6 mm from the opening of the glass container. The orifice shall also be so positioned that the jet blows horizontally into the central arc of the opening of the circling glass container.

2. Position the thermometer specified in B.3 so that the end of the bulb of the thermometer is within approximately 25 mm of a line level to the center of the shaft holding the revolving carriage.

3. Level the oven so that the horizontal axes of the glass containers are level when in position in the carriage.

4. Preheat the oven for a minimum of 16 h prior to testing with the controls on the setting, which will be used during the operation of the oven. The control thermostat shall be adjusted so that when the oven is fully loaded and the air is on, it will return to 163 ± 0.5˚C within the 10-minute warm-up period.

D. PROCEDURE

1. The sample as received shall be free of water. Heat the sample in its container with a loosely fitted cover in an oven not to exceed 163˚C for the minimum time necessary to ensure that the sample is completely fluid. Manually stir the sample, but avoid incorporating air bubbles.

2. Pour 35 ± 0.5 g of the sample into each of the glass containers required to obtain sufficient material for the tests that are to be run on the residue.

   NOTE: For referee testing, eight (8) glass containers of the sample will be required. When the quantitative value of the mass change is desired, use two separate bottles for this determination.

3. Allow the bottles to cool to room temperature. If mass loss is being determined, weigh each of the two bottles being used for this separately to the nearest 0.001 g.

   NOTE: Do not use the residue from the mass loss determination for other tests.

4. With the oven at operating temperature, arrange the containers holding the asphalt in the carriage so that the carriage is balanced. Fill any unused spaces in the carriage with empty containers. Close the door and rotate the carriage assembly at a rate of 15 ± 0.2 RPM. Start the air flow at a set rate of 4000 ± 200 mL/min. Maintain the samples in the oven with the air flowing and the carriage rotating for 85 min. The test temperature, 163 ± 0.5˚C, shall be reached within the first 10 min; otherwise, discontinue the test. At the conclusion of the processing period, remove the containers from the oven. If the mass loss is not being determined, proceed in accordance with Section D.5. For the glass containers on which the loss is being determined, cool to room temperature in a desiccator, then weigh to the nearest 0.001 g, and calculate the loss on the basis of the asphalt in the container. Discard the residue cooled for the mass loss determination.

5. Immediately pour all of the free-flowing residue from each bottle into a container. Then scrape as much of the remaining residue as is practical into the container. Use a container that is large enough so that when all of the residue is collected, the container is not over 75 % full. Do not let the moving film bottles cool and do not reheat the bottles to obtain more residue. Proceed as described in Section D.6.

6. Test the residue within 24 h of performing the moving film test.

E. REPORT

Report the results from the moving film test in terms of the physical changes in the asphalt brought about by this method. These values are obtained by performing appropriate tests on the asphalt before and after the moving film oven cycle.

F. SAFETY AND HEALTH

Prior to handling, testing or disposing of any waste materials, testers are required to read: Part A (Section 5.0), Part B (Sections: 5.0, 6.0 and 10.0) and Part C (Section 1.0) of Caltrans Laboratory Safety Manual. Users of this method do so at their own risk.

REFERENCES:
ASTM Designation E 1

End of Text
(California Test 346 contains Pages 6)

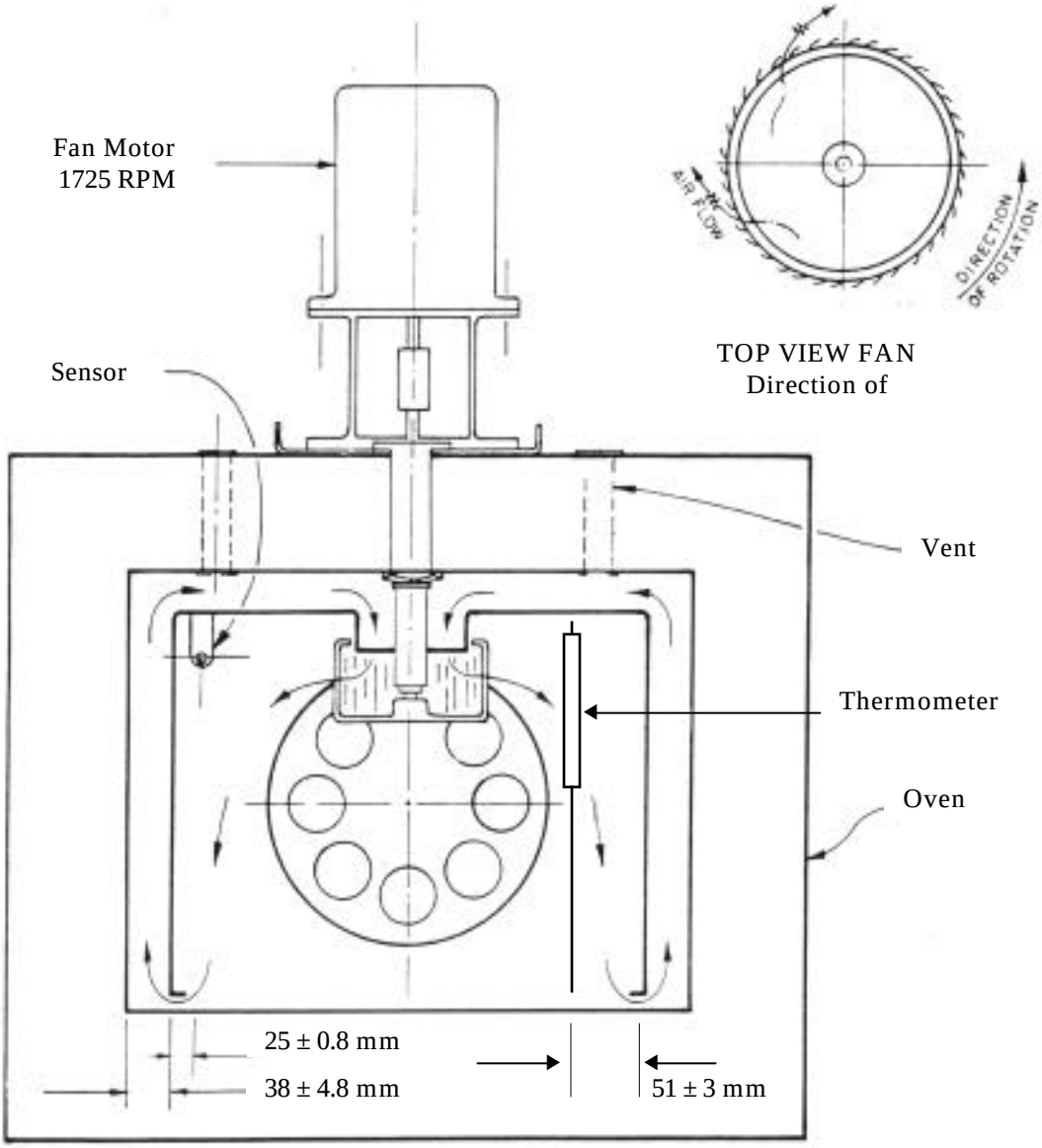

FIGURE 1

Front View
Schematic of Air Flow

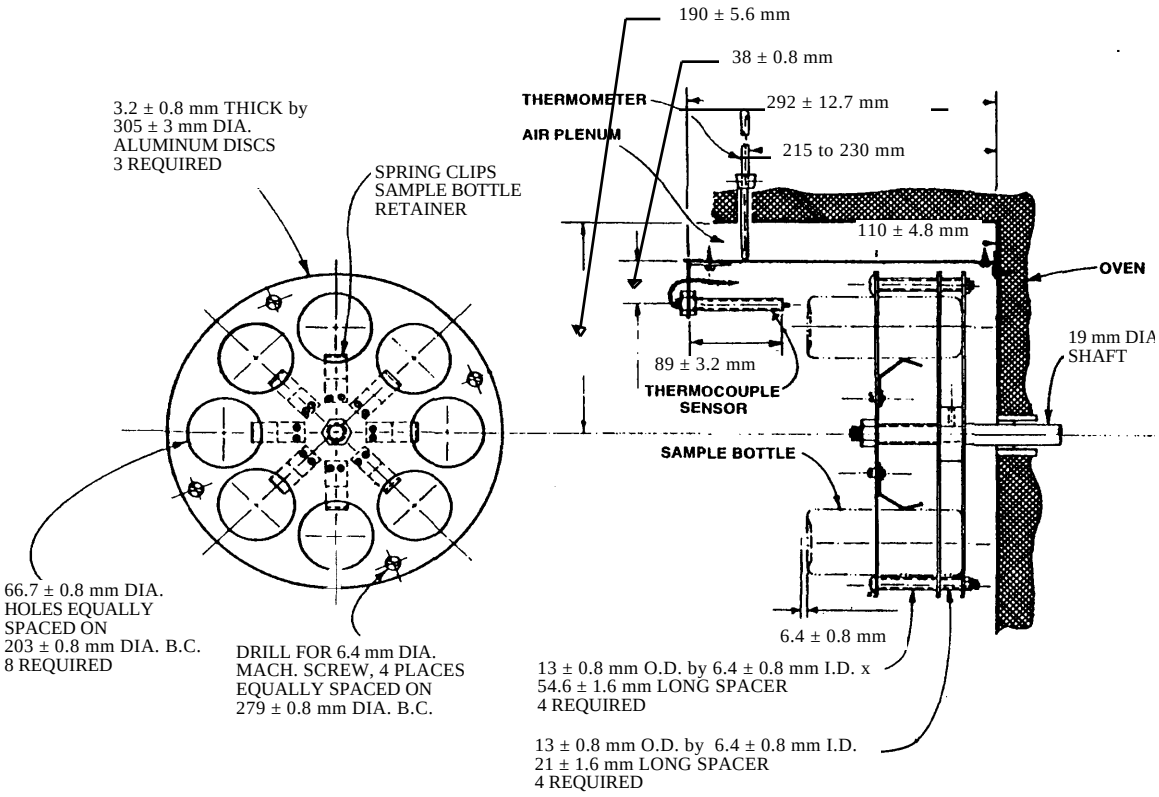

FIGURE 2

Circular Metal Carriage

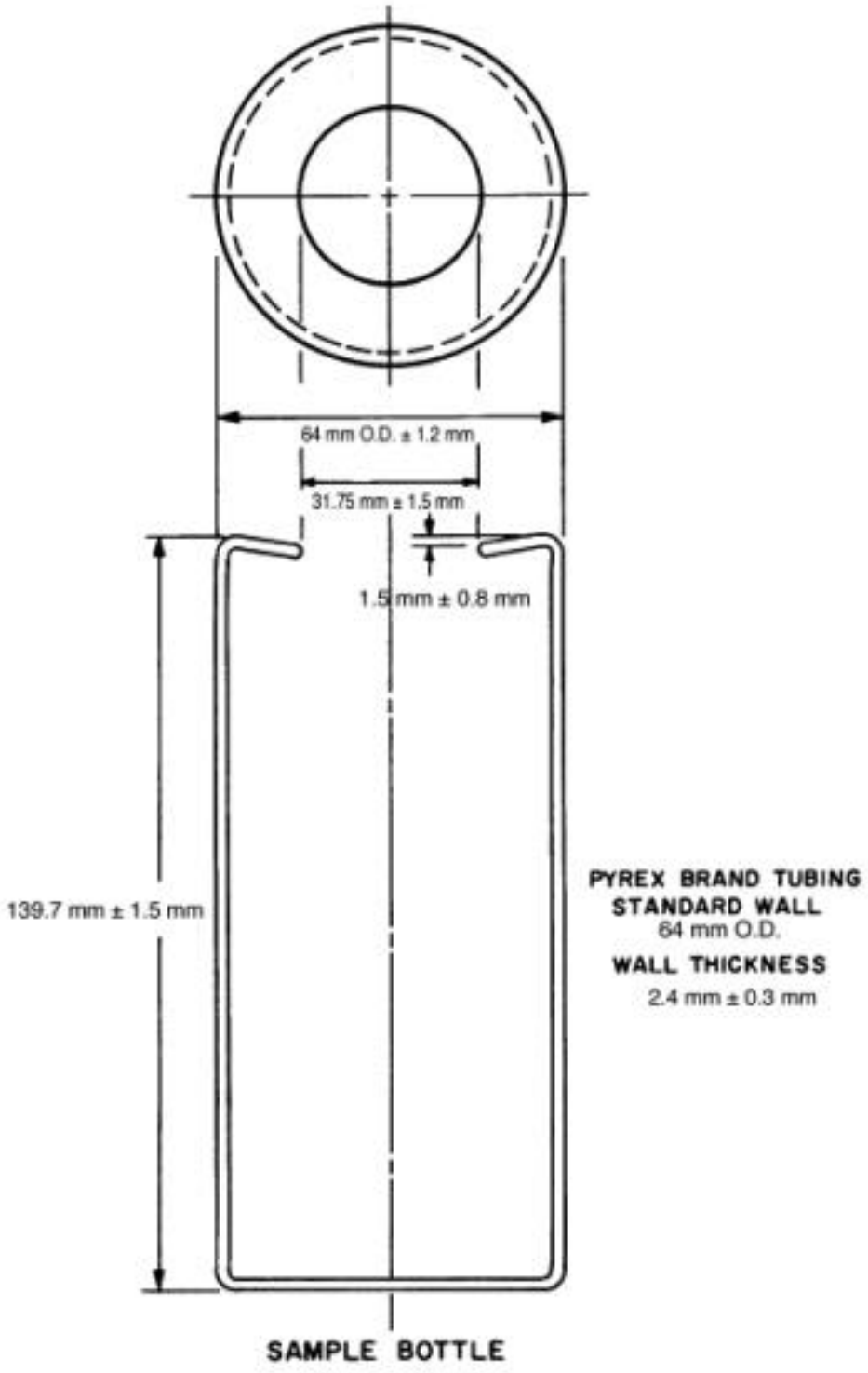
64 mm O.D. ± 1.2 mm
31.75 mm ± 1.5 mm
1.5 mm ± 0.8 mm
139.7 mm ± 1.5 mm
PYREX BRAND TUBING
STANDARD WALL
64 mm O.D.
WALL THICKNESS
2.4 mm ± 0.3 mm
SAMPLE BOTTLE

FIGURE 3